

DOCUMENT RESUME

ED 219 623

CE 033 358

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TITLE Trainability of Academic Skills in the Elderly.
SPONS AGENCY National Inst. of Child Health and Human Development (NIH), Bethesda, Md.
PUB DATE Mar 82
GRANT NICHHD-HD-05951
NOTE 19p.; Paper presented at the Annual Meeting of the American Educational Research Association (New York, NY, March 19-23, 1982).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Ability; Adult Development; Age Discrimination; Aging (Individuals); *Cognitive Ability; *Cognitive Measurement; Cognitive Tests; *Educational Attainment; Educational Gerontology; *Older Adults; Problem Sets; *Testing Problems; *Transfer of Training

ABSTRACT

The typical approach to studying the cognitive competencies of the elderly involves giving the same task to samples of elderly adults and college students. On such comparisons of performance of cognitive tasks, the elderly have almost always been found to be inferior, which is interpreted as indicating an irreversible age-determined decline in cognitive ability. A recent study was conducted to test the hypothesis that success on experimental tasks depends upon skills and strategies associated with formal schooling and that the elderly, removed in time from the school setting, no longer have ready access to these skills and strategies. The research involved an attempt to determine whether, within an elderly population, academic skills could be reinstituted through brief intervention and whether the ease of doing so would depend upon level of schooling. The basic technique involved giving a group of 99 white women with 6 to 17 years of schooling and a mean age of 72.6, matrix problems to solve independently. If they were unable to do so, progressively more explicit prompts for solution were provided. Transfer of training was assessed both by the extent to which subjects reduced the number of prompts needed and by their performance on novel problems for which no hints were available. It was found that training elevated the score on transfer across all educational levels and problem types (although college-educated subjects scored higher). An implication from the research is that to test elderly people in the same manner as school children and to assume the comparability of the results ignores the fact that the elderly are not members of the test-taking society. Such procedures are unfair to them and show a loss of cognitive ability that may not reflect reality. (KC)

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ED219623

Trainability of Academic Skills in the Elderly

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Paper presented at the Annual Meetings of the American Educational Research Association, New York City, March 19 - 23, 1982.

This report is based on the author's doctoral dissertation "Cognitive Consequences of Education: Transfer of Training in the Elderly", University of Illinois, 1980. Financial support was provided by NICHD Grant HD 05951, awarded to Ann Brown, the thesis director. The author would like to thank Ann Brown and Joseph Campione for their encouragement and advice throughout the course of the research, Dannine Roupp, Deborah Insel, Cindy Mervis, Roberta Jones, and Robert Linn for their assistance in various aspects of the data collection and analysis, and Virginia Valian for comments on a previous draft of this paper.

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The typical approach to studying the cognitive competencies of the elderly involves giving the same task to samples of elderly adults and college students. On virtually every cognitive task on which the performance of these populations has been compared, the elderly have been found to be inferior. This pattern of poorer performance by the elderly is generally interpreted as indicating an irreversible age-determined decline in cognitive ability. The research reported here explores the possibility that poor performance by the elderly reflects a lack of familiarity with the strategies required by and conventions associated with experimental tests of cognitive ability, rather than reflecting a general decline in cognitive ability per se.

Imagine for a moment that a general factor, perhaps "refusal to cooperate", underlies the elderly's performance in all experimental settings. This would result in poor performance on any task, and so long as subjects' refusal to cooperate was not detected, it would be possible to conclude that the elderly were deficient in any ability hypothesized to underlie any task presented to them. In other words, if a researcher believes that "Ability X" underlies successful performance on a particular task, then failure on that task is often interpreted in terms of the subject lacking the critical "Ability X." In fact, a more general factor, such as refusal to cooperate, may be responsible for failure. The attribution of failure to the absence of "Ability X" does not follow logically from poor performance; its absence may or may not be the source of the failure. However, inferences that the elderly "lack" Ability X have been rampant in gerontological research, and in the absence of alternative interpretations of the elderly's typically poor performance, have generally been sufficiently convincing to be widely accepted.

Of course the elderly do not refuse to cooperate in experimental settings, but this example contains more than a grain of truth. The tasks used to assess cognitive competencies almost always require skills and attitudes toward problem-solving which are known, on the basis of cross-cultural research,

to develop as a result of formal education (Brown & French, 1979a;1979b; Sharp, Cole, & Lave, 1979). Due to their immersion in an academic setting, college students are experts in these skills and attitudes. It can be argued that the elderly, by virtue of their temporal removal from an academic setting, are novices. Thus it may be that the elderly's typically poor performance in experimental settings results from an unfamiliarity with, and inability to readily access, the skills and attitudes associated with formal education, rather than form a deficit in any particular cognitive competencies assumed to underlie successful task performance.

The basic premises of this argument are that success on experimental tasks depends upon skills and strategies associated with formal schooling and that the elderly, removed in time from the school setting, no longer have ready access to these skills and strategies. This assumption underpins the research reported here, which involved an attempt to determine whether, within an elderly population, academic skills could be reinstituted through relatively brief intervention, and whether the ease of doing so would depend upon level of schooling.

The procedure used in this study was an adaptation of the Soviet method for assessing intelligence, which is based on Vygotsky's (1978) theory of a Zone of Potential Development. This procedure is a training paradigm which permits assessment of both the subjects' speed of learning and the flexibility with which they are able to transfer that which is learned. The basic technique, described by Brown and French (1979b), involves giving the subject a problem to solve independently, and then, if he is unable to do so, providing progressively more explicit prompts for solution. Transfer is assessed both by the extent to which subjects reduce the number of prompts needed across problems of the same general type, and by their performance on novel problems for which no hints are available.

The primary prediction being tested in the study reported here was that such training would facilitate performance on a transfer task, thereby indicating that the poor performance typically shown by elderly subjects was not necessarily the result of irreversible cognitive decline, but might instead be attributed to a lack of fluency with test-taking skills. A secondary prediction was that both speed of learning and flexibility of transfer would be a function of the length of school attendance.

Method

The subjects were ninety-nine white, community-dwelling women with six to seventeen years of schooling. Their mean age was 72;6. Women, and, to as great an extent as possible, housewives, were selected in order to provide a rough control for the variability in cognitive demands associated with different careers. The task on which subjects were trained was an adaptation of Raven's Progressive Matrices Task. Matrix problems were selected for training because their solution is not dependent on particular knowledge acquired in school, but is dependent on problem solving strategies associated with Neisser's (1976) conception of academic intelligence. This task is also particularly interesting in light of Jensen's (1973) claim that scores on so-called "culture fair" tests, such as matrix tests, are not amenable to improvement through practice or training.

There were three treatment conditions. The design is shown in Table 1. Fifty-three subjects completed Raven's 60 item Standard Progressive Matrices Test (RSPM) followed by training and transfer problems. These subjects more or less equally represented four levels of education: no highschool, some highschool, highschool graduation, and some college.

Thirty subjects received only the transfer problems. These subjects were roughly equivalent to the trained subjects in educational level. Seventeen subjects received the RSPM followed by the transfer problems. There were no college educated subjects in this group. More subjects were assigned to the training group to provide an adequate assessment of the relationship between educational level and performance. The unequal assignment of subjects to conditions was not problematic in the data analyses.

Insert Table 1 about here

There were eighteen training problems and twelve transfer problems. All of these problems were 3×3 matrices, with the last element of the third row and column missing. Three different rules were trained: rotation, addition, and superimposition. The twelve item transfer test consisted of four problems based on each of the three rules. The training and transfer items for the superimposition rule are shown in Figure 1. The training items were presented in a fixed easy to hard sequence. The presentation of the transfer problems was randomized. Two of the four transfer problems for each rule type measured "specific" transfer; they were isomorphic to problems presented during training. One item, designed to measure near transfer, required the target rule with an added complexity; the far transfer item required a more fundamental adaptation of the target rule.

Insert Figure 1 about here

The training and transfer problems differed from the multiple-choice RSPM problems in that the subjects had to construct rather than select an answer. For each training and transfer problem, a set of transparencies was created, consisting of sufficient shapes to produce a variety of matrices, including the correct one. Additional materials included a blank matrix board on which the transparencies could be placed, and a board with a cutout section which could be placed over a matrix to "highlight" any row while concealing the other two. During training, if a response was incorrect, the experimenter provided a series of graduated prompts (Described in Table 2) until the correct answer was obtained. The transfer test immediately followed the training series; for these problems subjects continued to construct their answers from the transparencies, but received no prompts or feedback.

Insert Table 2 about here

Results and Discussion

Educational Level:

Before describing the control conditions and assessing the effectiveness of training, I will very briefly address the second prediction, namely that educational level would affect the ease of training and the flexibility of transfer. During the training phase, educational level did affect both the number of problems solved independently, that is, without prompts, and the number of prompts required if a problem was not solved independently. Educational level was also related to the number of transfer problems solved

correctly. Pairwise comparisons showed that the effects of educational level during both the training and transfer phases were due to the college educated subjects differing from subjects at the other educational levels, whereas these subjects did not differ significantly from one another. After partialling out pretest performance, as measured by the RSPM, educational level correlated significantly with performance on the transfer items, but not with the ease of training, as measured by the number of training problems solved independently.

Several factors make these results somewhat difficult to interpret in terms of the initial hypothesis that educational level would affect ease of training and flexibility of transfer. First, college-educated women constitute a very small proportion of the cohort under consideration, and probably represent a privileged minority who differ from less educated peers in a number of ways. Since the effects of educational level were attributable primarily to these subjects, this limits any strong conclusions we might wish to make regarding the long term cognitive consequences of education. The attempt to control for pretraining competency by partialling out performance on the pretest produces its own problems, because it is not clear exactly what factors were responsible for the initial RSPM performance and therefore were being partialled out along with it. So while the study being reported here does not dispute our original prediction that educational level would predict ease of training and flexibility of transfer, it does not offer the unequivocal support that we might have liked.

Effects of training:

As shown in Table 1, there were two control groups. One group received only the twelve item transfer set, whereas the other group received both the RSPM pretest and the twelve item transfer set. Subjects from all groups were drawn from the same general population, with the exception that the second control group did not contain any college educated subjects.

To compare the performance of subjects who received only the transfer items with those who received both the RSPM and training items prior to receiving the transfer set; an education by condition by transfer type analysis of variance was computed. All three main effects, and no interactions, were significant. The means and significance levels are shown in Table 3. These results indicate that there was an effect of training, and that it was what Ann Brown has termed a level rather than a pattern effect (1975). That is, training elevated the score on transfer across all educational levels and problem types more or less equally, rather than being particularly effective for a particular educational level or on a particular problem type.

Insert Table 3 about here

This is a distinction of great importance to psychologists and educators who are interested in the generalizability of particular training. When we train particular skills or strategies, we are typically hopeful that the information acquired will generalize to new situations rather than being limited to the particular context in which it is learned. However, training attempts generally result in improvement on the particular type of problem for which training is provided and very little improvement on problems requiring different rules (Campione & Brown, 1978). In this study however, training resulted in roughly equal improvement on problems representing specific, near, and far transfer, and was more or less equally effective for subjects at all educational levels.

On the one hand, we were glad that we achieved results which more closely match the ideal than do the results of most training studies. On the other hand, we were initially puzzled that we failed to replicate what is a very widespread finding. What could account for the difference between the effects of training we obtained and those which are typically obtained? We suspect that the difference is due to the fact that our subjects were not really cognitively impaired, and thereby differed from subjects in most training studies.

Training studies typically focus on populations whose deficiencies in the target skills impair their successful adaptation to their environment; that is, they are directed toward children who have earned the label retarded or learning disabled through failure to meet academic demands. Retarded children have underlying deficiencies which mediate their performance in a variety of areas, including their responsiveness to training. While the elderly do show poor performance on a variety of cognitive tasks, they are not ordinarily in an environment which requires that they utilize the skills tapped by such tasks. It is likely that the etiologies of poor performance differ in the two groups, for example, lack of practice in the elderly vs. lack of ability in the children. It could be argued that the elderly's generalization of training provides secondary evidence that they in fact do not suffer underlying cognitive deficits. This claim is of course in accord with the hypothesis proposed here.

Before discussing this further however, it is necessary to describe the performance of subjects in the Control-2 group. The results of the comparison between the Training and Control-1 subjects left open the possibility that the trained subjects' superior performance was due to the 'warm-up'

provided by the initial exposure to the RSPM rather than to the training session per se. The second control condition addressed this possibility. Subjects in this condition were seen twice, first to complete the RSPM and then to complete the twelve item transfer set. Since only level differences were found in the comparison between the trained and Control-1 subjects, the basic question of whether the trained subjects' superior performance was a result of prior exposure to the RSPM could be addressed without the inclusion of college educated subjects. Of course, all between conditions comparisons which included the Control-2 group were based only on the non-college educated subjects who participated in the various conditions.

A comparison of baseline performance on the RSPM by subjects in the trained and Control-2 groups showed that the two groups were virtually identical in initial competency. Subjects in the Control-2 condition averaged 55% correct, and those in the Trained condition averaged 51% correct. Thus, within the educational range being sampled, the Control-2 and Trained subjects were equivalent prior to training.

For subjects with twelve or fewer years of education, overall mean performance on the transfer problems was 46% for the subjects in the trained condition, 23% for subjects in the Control-1 condition, and 27% for subjects in the Control-2 condition. Analyses of the total number of items correct on the transfer set indicated that the two control groups were significantly different from the trained group, but not different from one another. Thus this pair of control conditions indicates that the training procedure did indeed improve performance on the transfer problems.

Conclusion

Even though it was impossible to reach definitive conclusions regarding the long-term cognitive consequences of schooling, this study did garner considerable support for the major hypothesis being addressed, that is, that training may have a substantive effect on the cognitive competencies demonstrated by the elderly. The training was simply too brief for anyone to convincingly claim that something like "underlying cognitive competency" was affected, or that cognitive decline was reversed. Instead, it seems very likely that the training simply taught, or perhaps reactivated the subjects' knowledge of, some basic components of academic intelligence; namely that there is one right answer, that it is rule governed, and that it can be reached through a step-by-step analysis of the subproblems within a problem. In addition, we can also assume that training served to familiarize subjects with task-specific demands such as manipulating the transparencies, reading rows and columns in a left-right and up-down manner, etc.

There are several levels at which one can consider the wider implications of this study. At a very applied level, we will obviously take very different positions on the issues of retirement policy and career changes in later life depending on whether or not we believe that the elderly are cognitively impaired and unable to learn new skills. The results of this study suggest that even very abstract skills are amenable to training in the elderly.

At a methodological level, the research reported here raises very serious questions about the legitimacy of the modal gerontological study (cf. Cohen, 1979) which compares the performance of college students and elderly

subjects one time on one task and concludes that the elderly lack the cognitive ability believed to underlie that task. Jokingly we can say that there is no point in going to the trouble to locate and test subjects because we know how such studies will turn out. Seriously, we can say that there is no point in doing such studies because they tell us next to nothing about the cognitive abilities of the elderly. Results obtained from such studies are seriously contaminated by -- among other things -- differences between the two populations' familiarity with testing contexts and their scripts for solving academic-type problems. To test elderly subjects in the same manner that school children are tested, and to assume that such standardization insures comparability of results for the two populations is a blind application of the experimental method which overlooks the fact that elderly subjects are, in a very real sense, members of a culture quite different from that inhabited by habitual test-takers and test-givers. In short, all of the warnings appropriate to the gathering and interpretation of data in cross-cultural settings (Scribner, 1976; Cole, Gay, Glick & Sharp, 1971) must also be heeded when conducting experiments with members of this culture who are not immersed in an academic environment.

I don't want to leave the impression that I don't believe there are any cognitive changes, even cognitive declines, associated with increasing age. In fact, I think that it is very likely that there are. However, despite the fact that there are hundreds of studies reporting age-related decline in cognitive ability, very few of them are sufficiently interpretable to allow us to draw intelligent conclusions about the cognitive consequences of aging.

Finally, at a very general level, I would like to point out that society's impression that they are incompetent feeds into the elderly's self-concept, and into the expectations all of us hold about what it will be like

to grow old. It could be argued that one of the most serious inequities psychologists have perpetrated is using methodologically ill-formulated studies to give scientific status to the issue of cognitive decline. To the extent that studies such as the one reported here change the method and assumptions psychologists bring to studying the elderly, they will alter what we, both as psychologists, and as a society, know about the cognitive consequences of aging.

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Table 1
Summary of Treatment Conditions

	RSPM* 60 items	Training 18 items	Transfer 12 items
Trained Subjects N = 53	X	X	X
Control-1 N = 30			X
Control-2 N = 17	X		X

*Ravens Standard Progressive Matrices Test

Table 2
Description of Graduated Prompts

1. First row or column highlighted, subject asked to identify rule, relation, or pattern operating.
2. Subject given transparencies necessary for construction of highlighted line and asked to construct it on blank matrix board.
3. Experimenter constructed the line, highlighted second line, asked subject to describe rule operating.
4. Subject asked to construct second line using transparencies.
5. Experimenter constructed line, provided rule, and asked subject to use rule to solve problem.
6. Experimenter demonstrated rule operating in first line, in second line, and showed subject how to use rule in third line.
7. Experimenter completed third line, explained how answer was arrived at.

Subjects were allowed to attempt problem solution after presentation of each prompt. After successful completion, a new problem was presented. Often the sequence of prompts was short-circuited after the third hint because the subject became too anxious to attend to questions and prompts. In these cases the experimenter demonstrated the correct solution and introduced the next problem.

Table 3

Mean percentage correct, by educational level
and transfer type, for subjects in the
Trained and Control-1 conditions

Condition:	Years of Schooling		
	less than 12	12	greater than 12
Control-1			
Transfer types	(N=10)	(N=9)	(N=11)
Specific			
Easy	33%	48%	70%
Specific			
Hard	23%	41%	61%
Near	7%	22%	45%
Far	0%	19%	39%
Overall	16%	31%	54%
Trained			
Transfer types	(N=24)	(N=14)	(N=15)
Specific			
Easy	72%	67%	87%
Specific			
Hard	56%	50%	80%
Near	39%	33%	56%
Far	24%	26%	58%
Overall	47%	43%	70%

Results of Analysis of Variance (education by condition by transfer type)

Educational level $F(2,27) = 12.0734$, $p < .0001$

Condition $F(1,77) = 13.7853$, $p < .001$

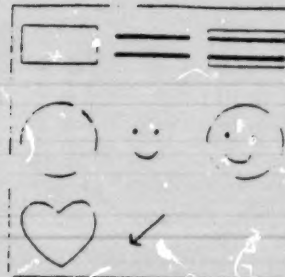
Transfer type $F(3,231) = 51.8937$, $p < .00001$

No significant interactions

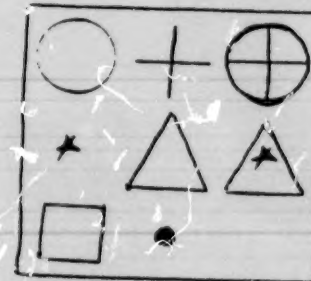
Figure 1
Superimposition Problems



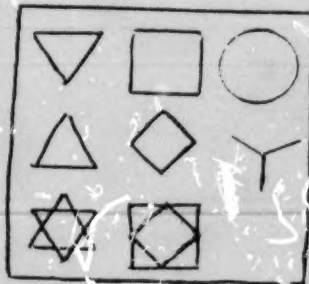
Training #1



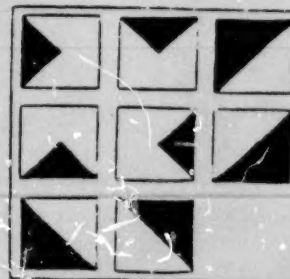
Training #2



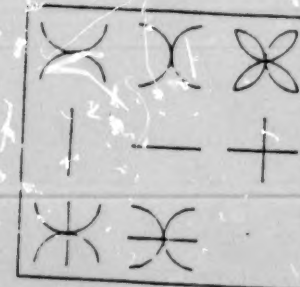
Training #3



Training #4



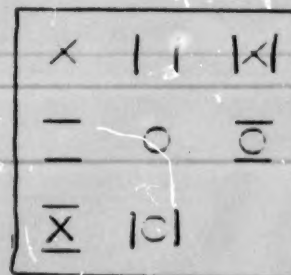
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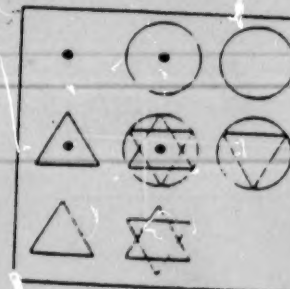
Training #6



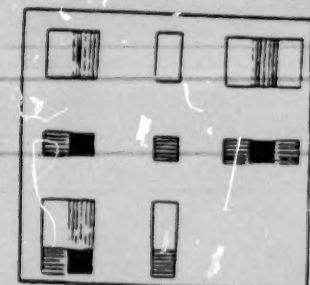
Specific Transfer



Specific Transfer



Near Transfer



Far Transfer